REMARKS

The office action of March 7, 2005 has been reviewed and its contents carefully noted. Reconsideration of this case, as amended, is requested. Claims 1 through 10 remain in this case, claim 1 being amended by this response.

Claim 1 was amended merely to correct typographical errors. No new matter has been added.

The numbered paragraphs below correspond to the numbered paragraphs in the Office Action.

Rejection under 35 U.S.C. §103

4. Claims 1-10 were rejected under 35 U.S.C. 103(a) as being unpatentable over Tadatomo et al. Applicant respectfully disagrees.

Tadotomo discloses "[a] GaN group crystal base member comprising a base substrate, a mask layer partially covering the surface of said base substrate to give a masked region, and a GaN group crystal layer grown thereon to cover the mask layer, which is partially in direct contact with the non-masked region of the base substrate, use thereof for a semiconductor element, manufacturing methods thereof and a method for controlling a dislocation line. The manufacturing method of the present invention is capable of making a part in the GaN group crystal layer, which is above a masked region or non-masked region, have a low dislocation density". (Abstract, see also Summary, Col. 1, lines 54-59) The mask layer is necessary in Tadatomo.

In contrast, the present invention discloses "[a] method of *in-situ* fabrication of dislocation-free structures from plastically relaxed layers grown on a semiconductor surface suitable for epitaxial growth is disclosed. This method solves the problem of lattice-mismatched growth." (present application, page 3, lines 5-7).

Using a mask in Tadatomo includes necessarily patterning a substrate by means of lithography. Patterning is explicitly mentioned in the Tadatomo. "The present inventors

previously proposed forming mask layers 2 having a lattice pattern on a base substrate I to avoid cracks…." (Col. 3, lines 38-40) The fabrication of a mask as shown explicitly in Figs 1 through 6 includes fabrication of a periodic pattern on a substrate. "The mask layer 2 may have any pattern such as a lattice pattern, a stripe pattern and a dot pattern." (Col. 4, lines 43–44).

In the present application, there is no lithographic process such as deposition of a mask. Instead, the present application uses an epitaxial approach. "The method produces coherent dislocation–free regions from initially dislocated and/or defect–rich layers lattice mismatched with respect to the underlying substrate, which does not contain any processing step before or after formation of defect–free regions". (present application, page 3, lines 13-16).

The present invention "preferably uses in situ formation of a cap layer on top of a dislocated layer. The cap layer preferably has a lattice parameter close to that in the underlying substrate, and different from that in the lattice mismatched epilayer in the no–strain state. Under these conditions, the cap layer undergoes elastic repulsion from the regions in the vicinity of the dislocations, where the lattice parameter is the most different from that in the substrate. The cap layer is absent in these regions." (present application, page 3, lines 16-21). Absence of the cap layer in the regions in the vicinity of the dislocations is the direct consequence of the elastic repulsion of the cap layer material from the regions in the vicinity of the dislocations.

Tadatomo et al. does not remove any dislocations. Instead, Tadatomo covers a substrate by a mask. "The surface of the base substrate 1 is partially covered by mask layer 2, and the GaN group crystal layer 3 grows from the non–masked region 11 of the base substrate 1 and covers the mask layer 2" (Col. 4, lines 7–11).

Another embodiment Tadatomo et al. includes alternates periodic repetition of masked and non–masked regions aimed to block propagation of dislocations upwards. "The GaN group crystal base member of claim 3, wherein a masked region and a non–masked region are alternately repeated periodically …" (Claim 4, Col. 17, lines 42–44).

In contrast, the present invention includes an annealing step resulting in the removal of material containing dislocations. "When a cap layer has a lower thermal evaporation rate than the underlying lattice–mismatched layer, the regions of this lattice–mismatched layer are selectively

evaporated at high enough temperatures, and only the coherent defect–free regions of the initially defect–rich lattice–mismatched layer remain on the substrate". (present application, Abstract, see also the Summary of the Invention).

Further, the difference between two inventions is clearly seen from the Figures. In Tadatomo et al. dislocations remain in the structure (Figs. 1(a), 1(b), and 4), they are just blocked by the mask. In the present invention, dislocation–contained regions are removed by evaporation (Fig. 2, the evaporation transforms Fig. 2(d) into Fig. 2(e)).

The materials in the device of the present invention have different thermal evaporation rates. Evaporation of uncovered dislocated regions is important in the present invention; thus, the proper selection of materials with certain thermal evaporation rates is also important. In contrast, Tadatomo does not disclose relationships between the thermal evaporation rates of the materials used.

The materials of the device of the present invention also have relationships between their lattice constants. Selective growth in the present invention occurs not due to the chemical difference between the materials, but due to the different strain state in the vicinity of the dislocations and far from the dislocations. Selective evaporation occurs due to a difference in thermal evaporation rate of the materials having rather similar chemical natures.

In contrast, Tadatomo et al. imposes a strong restriction on the mask material. "Said base substrate allows growth of a GaN group crystal in the C axis orientation as the thickness direction, and the mask layer is made from a material substantially free from GaN group crystal growth" (Col. 1, lines 59–63).

Regarding claim 1, the Examiner acknowledges that Tadatomo et al. does not specifically disclose the method steps claimed. However, the Examiner further states that there "is not any non-obviousness difference between the two final products." (present office action dated March 7, 2005, page 3, lines 13-14).

The Examiner states that Tadatomo et al. discloses a lattice-mismatched layer having at least one local dislocation.

"In the GaN group crystal base member of the present invention as shown in the embodiment of FIG. 1, the surface of the base substrate 1 is partially covered by mask layer 2, and the GaN group crystal layer 3 grows from the non-masked region 11 of the base substrate 1 and covers the mask layer 2.

The material of the above-mentioned base substrate 1 may be, for example, sapphire crystal (C face, A face), rock crystal, SiC and the like which are widely used to form GaN group crystal layers. In particular, sapphire substrate (C face) is preferred. The substrate may have a buffer layer of ZnO, MgO, AlN and the like on its surface to reduce the difference in the lattice constant and coefficient of thermal expansion between the substrate and GaN group crystal layer. In addition, a material having a thin layer of $In_x Ga_yAl_zN$ ($0 \leq X \leq 1$, $0 \leq Y \leq 1$, $0 \leq Z \leq 1$, $X+Y+Z=1$) such as GaN or GaAlN formed on said buffer layer may be appropriately used. Such base substrate can reduce the density of the dislocation newly generated from the non-masked region into a GaN group crystal layer 3 and afford a GaN group crystal layer 3 having fine crystallinity.

The mask layer 2 should be one, from which surface a GaN group crystal does not substantially grow. Examples of such material include non-crystalline materials such as nitrides and oxides of Si, Ti, Ta, Zr and the like, namely, SiO_2, SiN_x $SiO_{1-x} N_x$, TiO_2, ZrO_2 and the like. In particular, SiO_2, SiN_x and $SiO_{1-x} N_x$ are suitable which are superior in heat resistance and which allow relatively easy film formation and removal by etching. These materials may be formed into a multilayer structure". (col. 4, lines 6-36)

Figs 1a, 1b, and Fig12a in Tadotomo all show a GaN layer including dislocations. Tadotomo does not disclose any of those dislocations being eliminated; all of the dislocations in the original GaN layer are still present in the final product. All of the dislocations remain in the structure (see Figs. 1(a0, 1(b) and 4), they are just covered by the mask.

In contrast, in the product of the present invention, at least one dislocation is eliminated by local evaporation of the nearby region of the lattice-mismatched layer in the lattice-mismatched layer that originally has at least one local dislocation. Therefore, the final product in claim 1 is different from the product in Tadotomo, in that the dislocations in the lattice-mismatched layer have been eliminated in the lattice-mismatched layer of claim 1. This is a non-obvious and important difference. As discussed in the present application, "[t]he method

produces coherent dislocation-free regions from initially dislocated and/or defect-rich layers lattice mismatched with respect to the underlying substrate, which does not contain any processing steps before or after formation of the defect-free-regions." (present application, page 3, lines 8-11).

In addition, the semiconductor device in claim 1 includes a surface having a first lattice constant and a first thermal evaporation rate, a lattice-mismatched layer, having a second lattice constant and a second thermal evaporation rate, and a cap layer having a third lattice constant and a third thermal evaporation rate. The second lattice constant is different than the first lattice constant. The third thermal evaporation rate is lower than the second thermal evaporation rate. Tadatomo does not disclose any of these relationships in its device.

Since claim 1 includes one or more elements not disclosed in Tadotomo, claim 1 is not anticipated by Tadotomo. Reconsideration and withdrawal of the rejection of claim 1 is respectfully requested.

Claims 2-10, being dependent upon and further limiting claim 1, should also be allowable for that reason, as well as for the additional recitations they contain. Reconsideration and withdrawal of the rejection of claims 2-10 is respectfully requested.

Conclusion

Applicant believes the claims, as amended, are patentable over the prior art, and that this case is now in condition for allowance of all claims therein. Such action is thus respectfully requested. If the Examiner disagrees, or believes for any other reason that direct contact with Applicants' attorney would advance the prosecution of the case to finality, he is invited to telephone the undersigned at the number given below.

"Recognizing that Internet communications are not secured, I hereby authorize the PTO to communicate with me concerning any subject matter of this application by electronic mail. I understand that a copy of these communications will be made of record in the application file."

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